

IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

1. (previously presented) A method for implementing an extensible network-attached secondary storage in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said method comprising the steps of:

executing at least one of a plurality of application programs on a first computer,

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage stores therein a plurality of storage units which includes at least one application data used by said application programs,

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an object-based I/O function;

receiving in said secondary storage apparatus, from the first computer or a second computer different from the first computer an object access module that implements the object-based I/O function by using the block-based I/O function; and

receiving, said secondary apparatus from the first computer, an object-based I/O request for said application data and performing said object-based I/O request by executing said object access module.

2. (previously presented) A method for implementing an extensible network-attached secondary storage according to claim 1, wherein said object access module obtains a data value or location of data in a storage unit corresponding to a specification, which is either an object, an object offset, an object offset size, or an object tag specifying the type of data to be retrieved.

3. (previously presented) A method for implementing an extensible network-attached secondary storage in a system including a plurality of computers, at one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said method comprising the steps of,

executing at least one of a plurality of application programs on a first computer;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage stores therein a plurality of storage units; which includes at least one application data used by said application programs; and

registering or deleting to/from said secondary storage apparatus an object access module that implements an object-based I/O function by using a block-based I/O function.

4. (previously presented) A first computer according to claim 3, wherein said object access module obtains a data value or location of data in a storage unit corresponding to a specification, which is either an object, an object

offset, an object offset size, or an object tag specifying the type of data to be retrieved.

5. (currently amended) An object access module operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said object access module comprising:

wherein a first computer executes at least one of said application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage stores therein a plurality of storage units which includes at least one application data used by said application programs;

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an object-based I/O function;

wherein said object access module implements said object-based I/O function using block-based I/O function; and

wherein said object access module is sent from said first computer or a second computer different from said first computer to said secondary storage apparatus to cause said first or second computer to perform an object-based I/O request by executing said object access module.

6. (previously presented) An object access module according to claims, wherein said object access module when executed obtains a data value or location of data in a storage unit corresponding to a specification, which is either an

object, an object offset, an object offset size, or an object tag specifying the type of data to be retrieved.

7. (previously presented) A method for implementing an extensible network-attached secondary storage in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said method comprising the steps of:

executing at least one of plurality of application programs on a first computer;
wherein said secondary storage apparatus includes a storage medium
secondary storage that can save data after shutting down of power source,

wherein said secondary storage stores therein a plurality of storage units
which include at least one application data used by said application programs,

wherein said secondary storage apparatus provides said first computer a
block-based I/O function and an object-based I/O function;

receiving, in said secondary storage apparatus from either the first computer
or a second computer different from the first computer object description data
indicating how said application data is stored on said secondary storage; and

receiving, in said secondary storage apparatus from said first computer an
object-based I/O request for application data and performing said object-based I/O
request by identifying the location of said application data on said secondary storage
apparatus by using said object description data.

8. (previously presented) A method for implementing extensible network-attached secondary storage according to claim 7, wherein said object description data is data for specifying an attribute or an inter-block reference based on an offset and size of said application data.

B 9. (previously presented) A method for implementing extensible network-attached secondary storage according to claim 7, wherein said object description data is data for specifying an attribute or an inter-block reference by a lexical analyzing program or a parser generating grammar of said application data.

10. (previously presented) A method for implementing extensible network-attached secondary storage according to claim 7, wherein said object description data is data for specifying a file format of said application data based on whether the data stored in a specific part of one or more storage units contain some specific value or pattern.

11. (previously presented) A computer operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said computer comprising:

wherein a first computer executes at least one of a plurality of application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source, and

wherein said secondary storage apparatus has stored therein a plurality of storage units including at least one application data used by said application programs;

wherein said computer register to or delete from said secondary storage apparatus object description data indicating how said application data is stored on said secondary storage apparatus; and

wherein said secondary storage apparatus provides a block-based I/O function and an object-based I/O function to said first computer.

12. (previously presented) A computer according to claim 11, wherein said object description data is data for specifying a data sequence or an inter-block reference of data in a storage unit based on an offset and a size of said application data.

13. (previously presented) A computer according to claim 11, wherein said object description data is data for specifying an attribute or an inter-block reference of data in a storage unit by a lexical analyzing program (parser) or a parser generating grammar of said application data.

14. (previously presented) A computer according to claim 11, wherein said object description data is data for specifying a file format of said application data

based on whether data stored in a specific part of one or more storage units contain some specific value or pattern.

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15. (previously presented) A method for implementing extensible network-attached secondary storage, wherein said object access module when executed obtains the object description data according to one of claims 7-14.

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16. (previously presented) A first computer according to claim 3, wherein said object access module when executed obtains the object description data according to one of claims 7-14.

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17. (previously presented) An object access module according to claim 5, wherein said object access module when executed obtains the object description data according to claims 7-14.

18. (previously presented) A method for implementing an extensible network-attached secondary storage in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said method comprising the steps of:

executing at least one of plurality of application programs on a first computer;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage stores therein a plurality of storage units including at least one application data used by said application programs;

wherein said secondary storage provides a block-based I/O function and an advanced I/O function for application programs to said first computer and maintains object access modules for implementing an object-based I/O function by using said block-based I/O function;

receiving, in said secondary storage from said first computer or a second computer different from said first computer, a module for implementing said advanced I/O function by using said object access module; and

receiving, in said secondary storage from said first computer, an advanced I/O request and performing said advanced I/O request by executing said object access module.

19. (previously presented) A computer operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary apparatus, said computer comprising:

wherein a first computer executes at least one of plurality of application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage has stored therein a plurality of storage units including at least one application data used by said application programs;

wherein said secondary storage apparatus operating as said first computer or as a second computer different from said first computer provides to said first computer a block-based I/O function and an advanced I/O function for said application programs;

storing in said secondary storage apparatus an object access module that implements the object-based I/O function by using the block-based I/O function; and

registering to or deleting from said secondary storage apparatus a function module that implements said advanced I/O function by using said object access module.

20. (previously presented) A program module operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said program module comprising:

wherein a first computer executes at least one of plurality of application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage apparatus includes a plurality of storage units which stores therein at least one application data used by said application programs;

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an advanced I/O function for said application programs;

wherein said program module is sent from said first computer or a second computer different from said first computer to said secondary storage apparatus to be executed therein; and

wherein said program module provides said advanced I/O function by using module that implements the object-based I/O function by using the block-based I/O function.

21. (previously presented) A secondary storage apparatus having a protection module, operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said secondary storage apparatus comprising:

wherein said first computer executes at least one of a plurality of application programs;

a storage medium that can save data after shutting down of power source,

wherein said secondary storage apparatus has stored therein a plurality of storage units including at least one application data used by said application programs;

wherein said secondary storage apparatus provides to said first computer a block-based I/O function and an advanced I/O function for said application programs;

wherein said secondary storage apparatus maintains an object access module that implements the object-based I/O function by using the block-based I/O function, and a function module that implements said advanced I/O function by using said object access module; and

wherein said protection module determines a method invocation to be allowed or denied when said function module attempts to invoke a method in the object access module.

22. (previously presented) A protection module according to claim 21, wherein said protection module is registered to or deleted from said secondary storage apparatus by said first computer or a second computer different from said first computer.

23. (previously presented) A method for implementing an extensible network-attached secondary storage in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said method comprising the steps of:

wherein said first computer executes at least one of a plurality of application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage apparatus has stored therein a plurality of storage units including at least one application data used by said application programs;

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an advanced I/O function for said application programs;

wherein said secondary storage apparatus maintains an object access module that implements the object-based I/O function by using the block-based I/O function, and a function module that implements said advanced I/O function by using said object access module;

4b¹ determining whether a method invocation is allowed or denied when said function module attempts to invoke a method in the object access module being received from said first computer or a second computer different from said first computer.

24. (previously presented) A computer operable in a system including a plurality of computers, at least one secondary storage apparatus, and a network or I/O cable for connecting said computers with said secondary storage apparatus, said computer comprising:

wherein said first computer executes at least one of a plurality of application programs;

wherein said secondary storage apparatus includes a storage medium that can save data after shutting down of power source,

wherein said secondary storage apparatus has stored therein a plurality of storage units including at least one application data used by said application programs;

wherein said secondary storage apparatus, operating as said first computer or said second computer different from said first computer, provides to said first computer a block-based I/O function and an advanced I/O function for said application programs;

wherein said secondary storage apparatus stores an object access module that implements the object-based I/O function by using the block-based I/O function, and a function module that implements said advanced I/O function by using said object access module;

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wherein said computer registers to or deletes from said secondary storage apparatus a protection module for determining a method invocation to be allowed or denied when said function module attempts to invoke a method in the object access module.

25. (currently amended) A locking module on a secondary storage apparatus in a system including a plurality of operable ~~with one or more of first~~ computers, at least one or more of secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said module comprising:

wherein said first computer ~~executing~~ executes at least one or more of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, and

wherein said secondary storage apparatus stores therein ~~including~~ a plurality of storage units ~~(blocks)~~, ~~said secondary storage storing in one or more of~~ blocks including at least one or more of a plurality of application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus ~~providing~~ provides said first computer with a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

wherein said secondary storage apparatus ~~storing~~ stores an object access module that implements the object-based I/O function by using the block-based I/O function; and

wherein when said object access module provides external devices a plurality of objects having containment, said locking module ~~providing~~ provides said external devices with a mutual exclusion function ~~with~~ based on the containment of said a plurality of objects ~~being taken into consideration~~ having containment.

26. (currently amended) A locking module according to claim 25, wherein: said locking module is registered to or deleted from said secondary storage apparatus by said first computer or a second computer different from said first computer.

27. (currently amended) A method for implementing an extensible network-attached secondary storage, ~~operable with one or more of first~~ in a system including a plurality of computers, ~~at least one or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said method comprising the ~~step~~ steps of:

executing on said first computer ~~at least one or more of~~ a plurality of application programs;

wherein said secondary storage apparatus ~~including includes a~~ storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, and

wherein said secondary storage stores therein ~~including a~~ plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ including at least one or more of application data ~~(object)~~ used by said application programs;

providing from said secondary storage apparatus to said first computer ~~with a~~ block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

maintaining on said secondary storage apparatus an object access module that implements the object-based I/O function by using the block-based I/O function;

receiving a locking module from said first computer or a second computer different from said first computer; and

when said object access module provides external devices a plurality of objects having containment, providing, by said locking module, ~~for providing said~~ external devices with mutual exclusion function based on ~~with~~ the containment of said a plurality of objects having containment ~~being taken into consideration~~.

28. (currently amended) A computer operable in a system including a plurality of ~~with one or more of~~ first computers, at least one or more of ~~secondary~~ storage apparatus, and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said computer comprising:

wherein a ~~said~~ first computer ~~executing~~ executes at least one or more of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, and

wherein said secondary storage ~~including~~ stores therein a plurality of storage units ~~(blocks)~~, ~~said secondary storage storing in one or more of blocks~~ including at least one or more of application data ~~(object)~~ used by said application programs;

wherein said secondary storage apparatus, operating as said first computer or ~~said a~~ second computer different from said first computer ~~running within a computer system for providing~~ provides to said first computer a block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O)~~;

wherein said secondary storage apparatus ~~storing~~ stores an object access module that implements the object-based I/O function by using block-based I/O function; and

wherein when said object access module provides external devices a plurality of objects having containment, said computer ~~registering~~ registers to or ~~deleting~~ deletes from said secondary storage apparatus ~~said a~~ locking module for providing external devices with mutual exclusion function ~~with~~ based on the containment of said plural objects ~~being taken into consideration~~ having containment.

29. (currently amended) A management computer operable in a system including a plurality ~~with one or more of first computers~~, at least one or more of secondary storage apparatus, one second computer operating as the ~~(a~~ management computer), and a network or I/O cable for connecting said first

computers and said second computer with said secondary storage apparatus, said management computer comprising:

wherein a said-first computer ~~executing~~ executes at least one or more of a plurality of application programs;

wherein said second computer ~~storing~~ stores a the-list of said secondary storage apparatus;

wherein said secondary storage apparatus ~~including~~ includes a storage medium (secondary storage) that can save data after shutting down of power source, and said secondary storage medium including a plurality of storage units (blocks);

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an advanced I/O function for said application programs, (advanced I/O) or an object-based I/O function;

wherein said first computer ~~sending~~ sends to said second computer a protection module (module) that implements said advanced I/O function;

wherein said second computer ~~receiving~~ receives said protection module to send it to part or all of said secondary storage apparatus listed-identified on the list;

wherein said secondary storage apparatus ~~receiving~~ receives said protection module;

wherein said first computer ~~transmitting~~ transmits to said secondary storage apparatus a request of said advanced I/O function;

wherein said secondary storage apparatus ~~invoking~~ invokes said protection module to perform said advanced I/O function.

30. (currently amended) A management computer according to claim 29, wherein: said management computer provides a compiler for compiling said protection module for said secondary storage apparatus to compile said module received from said first computer using said compiler in order to send a compiled module to part or all of said secondary storage apparatus.

B 31. (currently amended) A management computer according to claim 30, wherein: said management computer ~~storing~~ stores model data of said secondary storage apparatus, provides one or more compilers for compiling modules for each model of said secondary storage apparatus, to compile said module received from said first computer using said one or more compilers for the destination secondary storage apparatus, to send a compiled module to part or all of said secondary storage apparatus.

32. (currently amended) A method for implementing an extensible network- attached secondary storage, ~~operable with one or more of first~~ in a system including a plurality of computers, at least one or more of secondary storage apparatus, one second computer operating as (a management computer), and a network or I/O cable for connecting said ~~first~~ computers and said second computer with said secondary storage apparatus, said management computer comprising:

wherein said first computer ~~executing~~ executes at least one or more of a plurality of application programs;

wherein said second computer ~~storing~~ stores a ~~the~~ list of said secondary storage apparatus;

wherein said secondary storage apparatus ~~including~~ includes a storage medium (~~secondary storage~~) that can save data after shutting down of power source, and said ~~secondary storage~~ medium ~~including~~ includes a plurality of storage units (~~blocks~~);

wherein said secondary storage apparatus provides said first computer with a block-based I/O function and an advanced I/O function for said application programs, (~~advanced I/O~~) or an object-based I/O function;

wherein said first computer ~~sending~~ sends to said second computer a protection module (~~module~~) that implements said advanced I/O function;

wherein said second computer ~~receiving~~ receives said protection module to send it to part or all of said secondary storage apparatus ~~listed~~ identified on the list;

wherein said secondary storage apparatus ~~receiving~~ receives said protection module;

wherein said first computer ~~transmitting~~ transmits to said secondary storage apparatus a request of said advanced I/O function;

wherein said secondary storage apparatus ~~invoking~~ invokes said protection module to perform said advanced I/O.

33. (currently amended) A method for implementing an extensible network-attached secondary storage, operable in a system including a plurality ~~with one or more of~~ first computers, at least ~~one or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said first computers with said secondary storage apparatus, said method comprising the ~~step~~ steps of:

executing on ~~said a~~ first computer at least one or more of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium ~~(secondary storage)~~ that can save data after shutting down of power source, and said ~~secondary storage medium~~ including includes a plurality of storage units ~~(blocks)~~, ~~said secondary storage storing in one or more of blocks~~ including at least one ~~or more of~~ application data ~~(object)~~ used by said application programs;

providing from said secondary storage apparatus to said first computer ~~with a~~ block-based I/O function and an advanced I/O function for said application programs, ~~(advanced I/O)~~ or object-based I/O function;

receiving ~~a protection module (an~~ object access module) that implements said object-based I/O function or said advanced I/O function by using said block-based I/O function from said first computer or a second computer different from said first computer;

providing said secondary storage apparatus with a compiler for compiling said object access module into an executable form for faster execution;

compiling said object access module using said compiler on said secondary storage apparatus;

receiving ~~a request of an~~ object-based I/O request or an advanced I/O request of application data ~~on said object~~ from said first computer; and

performing the I/O ~~of said request~~ by executing said compiled object access module.

34. (currently amended) A method for implementing an extensible network- attached secondary storage, operable in a system including a plurality ~~with one or more of~~ first computers, at least one ~~or more of~~ secondary storage apparatus, and a network or I/O cable for connecting said first-computers with said secondary storage apparatus, said method comprising the ~~step~~steps of:

executing on said ~~a~~ first computer at least one ~~or more of~~ a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes storage medium ~~(secondary storage)-~~ that can save data after shutting down of power source, and said ~~secondary storage~~ medium ~~including~~ includes a plurality of storage units ~~(blocks), said secondary storage storing in one or more of blocks~~ including at least one ~~or more of~~ application data ~~(object)-~~ used by said application programs;

providing from said secondary storage apparatus to said first computer ~~with a~~ block-based I/O function and an advanced I/O function for said application programs ~~(advanced I/O);~~

for said advanced I/O function, providing a feature of replying, in response to a request from said first computer, information of a correspondence between a plurality of part of one object and said secondary storage apparatus for storing said part of object.

35. (currently amended) An apparatus for implementing an extensible network-attached secondary storage, operable in a system including a plurality ~~with one or more of~~ first-computers, at least one ~~or more of~~ secondary storage apparatus,

and a network or I/O cable for connecting said ~~first~~ computers with said secondary storage apparatus, said apparatus comprising:

wherein a said-first computer ~~executing~~ executes at least one or more of a plurality of application programs;

wherein said secondary storage apparatus ~~including~~ includes a storage medium (~~secondary storage~~) that can save data after shutting down of power source,
B and said ~~secondary storage~~ medium including includes a plurality of storage units (~~blocks~~), said ~~secondary storage~~ storing in one or more of blocks at least one or more of application data (~~object~~) used by said application programs;

means for providing said first computer block-based I/O function and an object-based I/O function;

means for receiving aan object access program module (~~object access module~~) that implements the object-based I/O function by using the block-based I/O function from said first computer or a second computer different from said first computer;

means for receiving said object access program module and for receiving a request of the object-based I/O function ~~on said object access module~~ from said first computer; and

means for executing said object access program module to implement the object-based I/O function.